

ADVANCES IN CONSTITUTIVE MODELLING OF METAL FORMING PROCESSES ACROSS DIFFERENT LENGTHSCALES

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ABSTRACT

The importance of metal forming processes in modern technology lies in the ease with which various shapes are produced by using the remarkable property of metals to plastically deform. Metals and their alloys are perhaps the most important class of materials used in engineering and technology, for which several important scales can be identified. The structure of a technical product commonly defines the macroscopic level whereas the microscale is characterized by a large number of grains with different crystal orientations. In the metal forming industry finite element simulations have played an important role in shortening the design cycle and reducing the pre-production costs of designing a new product. The accurate simulation of the material response during the forming operation requires the use of appropriate constitutive models, capable of realistically describing typical phenomena such as formability, springback, anisotropy and its evolution, etc. In addition, to understand the material behavior and to be able to design demanding material properties it is very important to comprehend the mechanisms taking place at the different scales and their influence on the macroscopic properties of the technical product.

The goal of this Minisymposium is to bring together engineers and scientists working in the broad field of material modelling across different scales with a direct application to metal forming simulations. The topics to be discussed range from material models based on dislocation microstructures in single and poly-crystals up to complete simulations of forming processes based on advanced continuum mechanical models motivated by the physics of the underlying scales. Within this scale range, topics such as complex material hardening/softening behaviour including anisotropy evolution, texture development under monotonic and stain path changes and numerical simulations for formability and springback as applications are discussed. Newly emerging materials including

advanced high strength steels (AHSS) such as TWIP and TRIP steels, and lightweight alloys such as aluminum and magnesium alloys will be of particular interest.